MAY 31 1921

VOL. 48 MAY, 1921 No. 5

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

ALEXANDER WILLIAM EVANS

Associate Editors

JEAN BROADHURST
JAMES ARTHUR HARRIS
GEORGE T. HASTINGS
MARSHALL AVERY HOWE
MICHAEL LEVINE
GEORGE ELWOOD NICHOLS
ARLOW BURDETTE STOUT
NORMAN TAYLOR

CONTENTS

Chondriomes in Chara. (Plate 3) . . . . . A. J. RIKER 141

Notes on Viburnum and the assemblage Caprifoliaceae . . W. L. McATEE 149

INDEX TO AMERICAN BOTANICAL LITERATURE 155

PUBLISHED FOR THE CLUB

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE BAHAMA FLORA

By NATHANIEL LORD BRITTON
Director-in-Chief of the New York Botanical Garden

AND CHARLES FREDERICK MILLSPAUGH
Curator of Botany in the Field Museum of Natural History

An octavo volume of 695 pages. Price $6.25, which includes postage

Published by the authors

COPIES MAY BE OBTAINED FROM

MR. G. K. ACKERMAN
LORILLARD MANSION BRONX PARK, NEW YORK CITY

THE BRYOLOGIST

PUBLISHED BY THE

SULLIVANT MOSS SOCIETY

The only magazine in English devoted wholly to Mosses, Hepatics, and Lichens. Bimonthly; amply illustrated; for beginners as well as for advanced students. Yearly subscription, $1.25. Address

EDWARD B. CHAMBERLAIN,
18 West 89th Street, NEW YORK CITY

PHOTOMICROGRAPHY

Photomicrographs and lantern slides made of vegetable and animal tissues and other substances to illustrate scientific papers, textbooks, lectures, etc. Specimens prepared for photographing.

Scientific accuracy secured by the use of color screens, Zeiss apochromatic oculars and Zeiss compensating eyepieces.

A. TENNYSON BEALS 2929 Broadway, NEW YORK
Phone Morningside 5420

Please mention the "Bulletin" when answering advertisements.

Vol. 48 No. 5

BULLETIN

OF THE

TORREY BOTANICAL CLUB

MAY, 1921

Chondriomes in Chara

A. J. RIKER

(WITH PLATE 3)

Chondriomes and mitachondria have received much attention in recent years. Foremost among the investigators along this line are Guilliermond, who has published a number of short papers, and Mottier (14). Both of these writers agree that chondriomes are distinct organs of the cells, and that they arise only from older chondriomes. These cell organs in *Chara* have been described as granulations that stain like nucleoli by Kaiser (11) and by Johow (10). Dębski (3, 4) found in the plasma of *Chara* bodies of a nucleolar structure, which probably arose from the nucleolus, and which showed strange enterings on the spindle fibers. Mirande (12), who has given this subject special attention recently, states that in the cells of *Chara* are found certain corpuscles that take the stains like nucleoli. He concludes that most of these corpuscles, which continue to multiply in the cytoplasm, are really nuclear in nature and are in part expelled by the nucleus itself. In the same paper he says that the chondriomes close to the nucleus migrate to the periphery of the cells, develop central vacuoles, and become chloroplasts. In due time he finds that they produce grains of starch.

For the investigation of the origin of these chondriomes in *Chara* and the rôle they play in the cells, material was collected near Covington, Kentucky, and identified according to Robinson

[The BULLETIN for April (48: 101–140. *pl. 2*) was issued April 4, 1921.]

(15) as *Chara fragilis*. A study was also made of *Chara verrucosa*, collected at Oberlin, Ohio.

METHODS

A number of killing agents were employed, including Carnoy's, Jeffrey's, Flemming's, Merkel's, Benda's, and dilutions of a 1 per cent chrom-acetic stock solution. The best results were obtained with Flemming's, Benda's and Merkel's solutions, all of which belong to the group recommended by Guilliermond (8) as causing the least change from the living condition. Care must be used while fixing the material because the chondriomes are rather easily destroyed by strong reagents. Flemming's weaker solution was tried at 0° C. and 50° C., but the best results were secured when the killing agent was of the same temperature as the water in which the *Chara* grew. Sections were cut at 5 μ and 7 μ, and stained with Haidenhain's iron-alum haematoxylin or Flemming's triple stain. Such stains as Giemsa's, Leishman's, and Wright's (Mallory and Wright) were also tried. These possess a certain value for this type of work because of the differential qualities and the rapidity of the staining, but they are likely to cause artefacts due to the precipitation of the stain. The lack of permanence of these stains is a further disadvantage.

Division figures are not easy to secure. Preliminary tests, in which growing tips were killed at intervals throughout the twenty-four hours, showed that mitotic division was most active at ten o'clock at night, and so for the final results the material was killed at this hour.

RESULTS

Since it is during the nuclear division that these chondriomes have their origin, it is necessary to study all the mitotic stages beginning with the resting cell.

While the cell is in the resting stage, the nucleolus shows refractive spots or granules. A similar appearance has been reported by Digby (5) and others in a variety of plants. As the spireme is formed, the nucleolus becomes irregular in shape, while it seems that streams of its contents flow out into the spiral thread (FIGS. 1 and 2). Mottier (13), while writing about nucleolar observations, says it is reasonable to suppose that the

nucleolar substance contributes materially to the growth of the chromosomes. On the same subject Andrews (1) says, "it is probably utilized as food in the growth of chromatic masses." Duggar (6) found an interesting connection between the chromatin content and the nucleolus, while Gardner (7) writes that the nucleolus is the important chromatic center, and that during division it becomes transformed into chromosomes. Wager (17) reports that during spireme formation the nucleolus becomes irregular in shape, undergoes ameboid changes of form, and then disappears just before the formation of the chromosomes. This describes exactly the changes that were observed in the present study of the growing tips.

In the metaphase and following stages the chromosomes remain entirely intact (FIG. 3). There is no sign of disintegration either of the central or outer portions. Hegner (9), working on the paedogenetic larvae of *Miastor*, finds that when the somatic cells become differentiated the middle portions of the chromosomes break up into granules which divide and go to the poles, while the swollen ends are cast into the cytoplasm. Boveri (2) has shown in *Ascaris* that when the cells specialize portions of the chromosomes separate off and disintegrate. But nothing of this kind occurs in *Chara*. Here the chromosomes migrate to the poles in the usual manner, with the mantle fibers extending from the center of the chromosomes. In the anaphase sixteen chromosomes move to each pole, corroborating the count of sixteen to eighteen made by Strasburger (16).

In the region of the median plate, after the chromosomes have been drawn away, a varying number (twelve to sixteen in *C. fragilis* and in *C. verrucosa* even more) of chromatic granules are found (FIG. 4), which are more or less globular in shape and which take the stains just as the chromosomes do. These granules, which are called prochondriomes hereafter, seem to lie between the spindle fibers and do not make connection with the mantle fibers. In size they vary from 0.6 μ to 1.4 μ in diameter, and the volume is calculated to be from 0.117 cu. μ to 1.47 cu. μ. As the chromosomes merge together in the telophase, these prochondriome granules may fuse so as to form eight or ten larger granules (FIG. 5), some of which may be up to 2.5 μ in diameter, or 4.9

cu. μ in estimated volume. The chromosomes are 0.7 μ in thickness and 5–6 μ in length, which gives a calculated volume of 2.37 cu. μ. It is estimated that the amount of chromatic material left behind in some cases may be equivalent to six or eight chromosomes, or almost half the amount of chromatin that makes up one of the daughter nuclei.

At the poles the chromosomes do not fuse directly into the daughter nucleus, but groups of them form pre-nuclear masses (Fig. 5), each of which contains a deeply stained chromatic spot resembling a nucleolus surrounded by a clear area. Then these pre-nuclear masses rapidly fuse into one large daughter nucleus (FIGS. 5–7).

The prochondriomes still persist on the median plate during the formation of the daughter nuclei. They do not disintegrate but soon migrate into the cytoplasm, where they divide repeatedly by fission to form bodies of different sizes. These are the granulations or chondriomes described by Mirande. Thus it appears that the greater number, at least, of the bodies staining as chondriomes in *Chara* may be nuclear in nature, and are, in part, expelled by the nucleus itself. On the other hand, this idea is exactly contrary to that of Guilliermond and Mottier, who say that chondriomes in general arise only from other chondriomes. Meves and Mottier suggest that, because chondriomes are such definite organs of the cell, they may be the bearers of certain hereditary qualities.

The leaves of *Chara* are formed by successive divisions of the tip cell. This tip cell seems to contain more of the chondriomes than any of the other cells. In fact the amount of chondriome material in the tip cells of the young leaves is approximately equal in many cases to the chondriome material in all cells below it. There is thus a progressive accumulation of chondriome material in the tip leaf cell during the successive divisions.

It is impossible actually to trace these prochondriomes to their position on the central plate, for they cannot be definitely picked out among the tangle of chromosomes in the metaphase. No more can their exact origin be seen. It would seem that they may be either (*a*) delayed chromosomes, (*b*) entire chromosomes which never go to the poles, (*c*) portions of chromosomes which

have been cut off, (*d*) unorganized portions of the spireme, or (*e*) chromatic material apart from and not included in the spireme. These possibilities are considered in order.

(*a*) If the original granules which first appear in the anaphase were delayed chromosomes, they would be considerably larger in size and greater in volume and would more nearly resemble the characteristic sausage shape of the chromosomes. Then, too, they would join the other chromosomes at the poles before the daughter nuclei were so nearly formed.

(*b*) Should they be chromosomes (in spite of their differences in size, shape and volume) which never go to the poles, there would be a progressive reduction in the number of chromosomes in the younger cells. Such, however, is not the case. Eight counts in different parts of the growing tip all gave sixteen as the constant chromosome number.

(*c*) They are not likely to be cut off portions of chromosomes, because in this event, the chromosomes in the cells which had undergone division a number of times would probably show a progressive diminution in size. According to Boveri (**2**) and Hegner (**9**) such diminution occurs in *Ascaris* and *Miastor*, where portions of the chromosomes are cut off at the time when somatic and germ cells are differentiated. In these cases the workers have shown that there is nuclear degeneration attendant on the specialization of the cells. However, nothing of this kind occurs in *Chara*. A careful comparison of the purely vegetative cells and those that might produce gametes, following the morphology according to Goebel, showed that there was no difference in the comparative size or number of the chromosomes or in the number of chondriomes produced.

(*d*) Unorganized portions of the spireme might form a few such prochondriomes. But there could not be so many unorganized portions as there are prochondriomes in the anaphase and still leave enough material for the full number of chromosomes which are formed.

ORIGIN OF THE PROCHONDRIOMES

(*e*) There is only one possibility of the origin of these prochondriomes which is not confronted with very serious objections. Since they probably are not chromosomes or portions of chromo-

somes, and do not seem to be unorganized portions of the spireme, they must be chromatin material not included in the spireme. The nucleolus is the most likely container of such material. In the resting stage the refractive spots or granules which may be seen in the nucleolus seem a probable source, because they resemble the prochondriomes in shape and staining reactions. It is possible that, if the nucleolus contains most of the chromatin which goes to make up the chromosomes, it could contain also the amount necessary to make the prochondriomes. Probably some of the granules of the resting nucleolus fail to pass into the spireme, when it is formed from some of the nucleolar material, and are then caught in the tangle of chromosome movement and carried on to the median plate. There they are left because of some difference between them and the granules of the chromosomes.

SUMMARY

1. Chromatic granules (prochondriomes) appear on the central plate in the anaphase of *Chara;* these do not disintegrate but migrate into the cytoplasm and become chondriomes.

2. These prochondriomes have their origin in the nucleolus.

3. Chondriomes are derived by fission from other chondriomes, but they are also produced as nuclear extrusions.

4. No difference in the prochondriome contents has been observed in the actively growing tip between the purely vegetative cells and those which may produce gametes.

5. The extrusion of these prochondriomes is apparently not connected with nuclear degeneration or differentiation of the germ and vegetative cells.

In conclusion the author wishes to acknowledge his obligation to Dr. Harris M. Benedict, of the University of Cincinnati, for his kind supervision during the investigation, to Professor F. O. Grover, of Oberlin College, for helpful suggestions, and also to other friends for the encouragement of their interest.

UNIVERSITY OF CINCINNATI

LITERATURE CITED

1. **Andrews, F. M.** Karyokinesis in *Magnolia* and *Liriodendron* with special reference to the behavior of the chromosomes. Beih. Bot. Centralbl. **11**: 132–142. *1 pl.* 1901.

2. **Boveri, T.** Die Entstehung des Gegensatzes zwischen den Geschlechtzellen und den somatischen Zellen bei *Ascaris megalocephala*. Sitzungsb. Ges. Morph. Physiol. München **8**: 114–126. *f. 1–6*. 1892.

3. **Dębski, B.** Beobachtungen über Kerntheilung bei *Chara fragilis*. Jahrb. Wiss. Bot. **30**: 227–248. *pl. 9, 10*. 1897.

4. ————————. Weitere Beobachtungen über *Chara fragilis*. *Ibid*. **32**: 635–670. *pl. 11, 12*. 1898.

5. **Digby, L.** The somatic, premeiotic and meiotic nuclear division of *Galtonia candicans*. Ann. Bot. **24**: 727–759. *pl. 59–63*. 1910.

6. **Duggar, B. M.** On the development of the pollen grain and embryo-sac in *Bignonia venusta*. Bull. Torrey Club **26**: 89–105. *pl. 352–354*. 1899.

7. **Gardner, B.** Studies on growth and cell division in the root of *Vicia Faba*. Contrib. Bot. Lab. Univ. Pennsylvania **2**: 150–182. *pl. 18* + *f. 1–3*. 1904.

8. **Guilliermond, A.** Contribution a l'étude de la fixation du cytoplasme. Compt. Rend. Acad. Sci. Paris **164**: 643–645. 1917.

9. **Hegner, R. W.** The history of the germ cells in the paedogenetic larva of *Miastor*. Science II. **36**: 124–126. *f. 1*. 1912.

10. **Johow, F.** Die Zellkerne von *Chara foetida*. Bot. Zeit. **39**: 729–743, 745–753. *pl. 7*. 1881.

11. **Kaiser, O.** Über Kerntheilungen der Characeen. *Ibid*. **54**: 61–79. *pl. 2*. 1896.

12. **Mirande, M.** Sur le chondriome, les chloroplasts, et les corpuscules nucléo-lavies du protoplasme des *Chara*. Compt. Rend. Acad. Sci. Paris **168**: 283–286. *pl. 1*. 1917.

13. **Mottier, D. M.** Nuclear and cell division in *Dictyota dichotoma*. Ann. Bot. **14**: 163–193. *pl. 11*. 1900.

14. ————————. Chondriosomes and the primordia of chloroplasts and leucoplasts. *Ibid*. **32**: 91–114. *pl. 1*. 1918.

15. **Robinson, C. B.** The Chareae of North America. Bull. New York Bot. Gard. **4**: 244–308. 1906.

16. **Strasburger, E.** Einiges über Characeen und Amitose. Wiesner-Festschr. 24–47. *pl. 1*. 1908.

17. **Wager, H.** The nucleolus and nuclear division in the root-apex of *Phaseolus*. Ann. Bot. **18**: 30–55. *pl. 5*. 1904.

Explanation of plate 3

The figures were drawn with a Bausch and Lomb 1.9 objective and ocular 10, tube length 160 mm., with a camera lucida. The slides, from which the figures were drawn, were stained with Flemming's triple stain. The magnification is about 1300 diameters.

FIGS. 1, 2. Prophase. The nucleolus contributes to the formation of the spireme

FIG. 3. Metaphase. The chromosomes are intact and show no sign of disintegration.

FIG. 4. Telophase. Chromatic granules (prochondriomes) are left on the median plate.

FIG. 5. Late telophase. The prochondriomes still persist during the organization of the chromosomes into prenuclear masses. (The total number of prochondriomes in the section is shown.)

FIGS. 6, 7. Late telophase. The prochondriomes migrate into the cytoplasm as the new wall is formed.

Notes on Viburnum and the assemblage Caprifoliaceae

W. L. McAtee

(WITH ONE TEXT FIGURE)

For some years the writer collected and studied the plants known as Caprifoliaceae, especially those of the genus *Viburnum*, with a view of revising at least the American forms of the latter. As realization of this project does not seem likely, a few matters of general interest arising during the investigation are here set forth.*

Stellate pubescence in Viburnum.—Although used in American botanical manuals the term stellate is not properly applied to the pubescence in our species of the genus *Viburnum*. True stellate pubescence, present in some exotic species, consists of trichomes having single points of attachment but which higher up are expanded or branched in a radiate manner. The pubescence of the United States species of *Viburnum* consists of simple hairs or of groups of such hairs, in the latter case each with its own attachment to the epidermis. The proper adjective to apply to these grouped hairs is fasciculate, a term which fits them exactly and which, if not employed in such instances, falls into unfortunate disuse. Since the fasciculation may involve any number from two to some twenty hairs, it is not a very good character to use in keys to the species. Still more unsatisfactory are descriptions of the vestiture in which the misleading modifier "stellate" is used for the denser tufts, as it implies a more fundamental difference than really exists between species which intergrade through every degree of fasciculation of the pubescence.

Relationship of Viburnum nudum and Viburnum cassinoides.—The characters of these forms intergrade extensively; the length of peduncle relative to that of cyme and the crenulations of the leaf margin, characters usually cited in keys, are fully connected by individual variations. The following with reference to the leaf

* The writer is obliged to Messrs. S. F. Blake and P. C. Standley for reading this paper and for making beneficial suggestions.

margins in these species may be of interest. In both, the leaf margin is more or less inrolled and the revolute character is most marked in *V. nudum*, which is described as having chiefly entire leaves. *Viburnum cassinoides* is described as generally crenulate-denticulate; however, the manuals note that each species occasionally has the leaf form of the other. If the revolute margin of the leaf of *V. nudum* be unrolled, crenulations are visible; thus, while the leaf really possesses the character supposed to be distinctive of *V. cassinoides*, the rolling in of the margin hides it and gives the leaf the appearance of entirety. The crenulations also are visible in many *V. nudum* leaves without unrolling them, that is, the margin is only folded back and the crenulations lie flat against the lower surface of the leaf. Both types can be found on a single plant as can also both long and short peduncles. The most reliable character for separating *V. nudum* and *V. cassinoides* is the shape of the pit of the fruit. The former has a simple, thin, lenticular pit, the latter an elongate, fusiform and sulcate one. Even these differences are more or less obscured by variations in certain specimens, but extreme southeastern *V. nudum* seems typical and so do northern specimens of *V. cassinoides*. Despite general inosculation of characters, therefore, the writer is inclined to rank these two forms as species, which hybridize more or less throughout the extensive common portion of their ranges.

Whorled leaves in Caprifoliaceae.—The possession of whorled leaves has a number of times been cited as one of a combination of characters distinguishing the Rubiaceae from the Caprifoliaceae. Seeing that this does not hold, the writer has noted, and in most cases collected, specimens showing verticillate leaves in various Caprifoliaceae. Such leaves are found most frequently on strong root-shoots, and according to the theory elaborated by Dr. R. T. Jackson,* indicate the ancestral condition. Species of *Viburnum* on which whorled leaves have been seen include: *V. Opulus*, *V. acerifolium* (whorled branches also), *V. dentatum*, *V. pubescens*, *V. Lentago*, and *V. Lantana*. *Sambucus canadensis* with verticillate leaves has been collected also, as well as the following species of *Lonicera: L. japonica*, *L. tatarica*, *L. fragrantissima*, *L. hispidula*, and *L. thibetica*. The last species as seen in the Arnold Arbore-

* Mem. Boston Soc. Nat. Hist. 5: 89–153. *pl. 16–25.* April, 1899.

tum frequently, one might almost say usually, has the leaves in whorls (three's, sometimes four's). The structure of plants with opposite leaves readily lends itself to the production of verticils, and as instanced here, the two types of foliation are hardly distinct enough to be given much weight in the major phases of classification.

Stipules in the Caprifoliaceae.—The most persistent efforts to name characters that will distinguish the Caprifoliaceae from the Rubiaceae have been centered on stipules. It being untrue that the assemblage of plants known as Caprifoliaceae entirely lacks stipules, various niceties of language have been used to indicate a difference where practically none exists. "Usually exstipulate," lacking "true stipules," and stipules if present adnate to the petiole are some of the expressions used. The first statement is more or less true but, demanding qualification, fails as a satisfactory character for distinguishing families. With respect to the second it must be said that special students of stipules agree in attributing such organs to the Caprifoliaceae.* Relative to the third definition, I may say that I have before me (gathered Maywood, Virginia, today, July 4, 1920) a piece of *Sambucus canadensis* with well-developed stipules on the petioles of leaves just beneath inflorescence, one of which when its leaf was stripped off remained adnate to the stem. In a specimen of *Viburnum Opulus* collected in the grounds of the United States Department of Agriculture, May 25, 1920, the stipules† are connected by wings which form a stipular cup completely encircling the stem (see Fig. 1). In some Rubiaceae the interpetiolar stipules are reduced to a mere stipular line and stipular lines are present in various caprifoils, notably *Sambucus;* moreover, what essential difference is there between the shallow cups formed by the interpetiolar stipules in some Rubiaceae and the perfoliate leaves of *Triosteum* and *Lonicera*? The idea that true stipules can be distinguished

* See an excellent paper on The Nature and Origin of Stipules (with review of the literature), by A. A. Tyler, Ann. N. Y. Acad. Sci. 10: 1–49. *pl. 1–3.* April, 1897.

† These stipules are unusually large, and bear glands on their stalks, thus suggesting that they are relics of a progenitor of the species having compound leaves. Similar stipules were collected on the same species in the Washington Monument Grounds, D. C., May 28, 1910, their likeness to leaves being greater, since they showed a tendency to lobing.

from the false by their pertaining to the stem rather than to the petiole appears to take little account of the fact that the petiole itself is a product of the stem and that in so plastic a kingdom as plants the appendages of the petiole and those of the stem from which it springs can not be otherwise than connected by every possible gradation. In the most typically stipulate plants, such as *Rosa* and *Trifolium*, the stipules are lobes at the base of the petioles, to which they adhere when the leaves are torn off. Even though they are true stipules they certainly are not adnate to the stem. All in all, it is certain that the stipules of Caprifoliaceae can

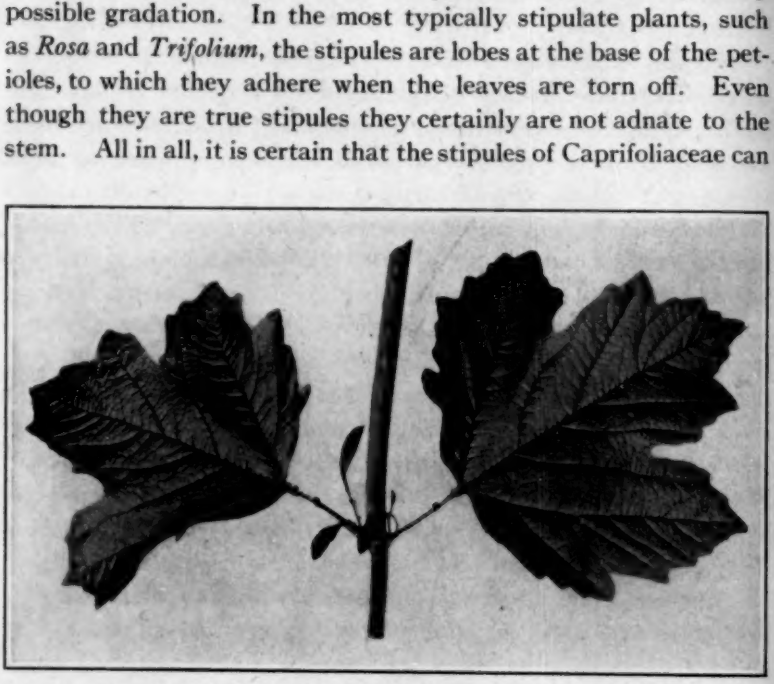


FIG. 1. Foliate development of stipules in *Viburnum Opulus*.

not be denied and judging from efforts that have been made, it is useless to seek a wording that will distinguish them in all of their phases from those of the Rubiaceae. Stipules are known in four of the genera (*Sambucus*, *Viburnum*, *Leycesteria*, *Lonicera*) of Caprifoliaceae, and perfoliate leaves in three (*Lonicera*, *Leycesteria*, *Triosteum*); and if we descend to the criterion of stipular line, as is done to evidence the genuineness of some Rubiaceae, we need exclude no caprifoils except those of the genus *Alseuosmia* which have alternate leaves.

Do the Caprifoliaceae merit family rank?—A rigorous yet entirely fair test of the validity of a classificatory group is: If

merged with its nearest relatives, will it remain a unit? Thus the Cichorieae, sometimes considered a family and sometimes ranged with the Compositae, do not in the latter process become scattered through the tribes of the Compositae but retain their integrity as a group. What happens to the Caprifoliaceae when this test is applied? It immediately becomes apparent that they have no character in common that will hold them together; they run to tribes in all parts of the Rubiaceae, some have one-seeded, others more than one-seeded carpels; some have dry fruits, others berries; some have the ovules suspended from the top of the ovaries, others from the septa. The variety of character with regard to verticillation of the leaves and the presence of stipules has been sufficiently set forth in preceding paragraphs. Some of the effects of this diversity upon their relation to the Rubiaceae are stated by Schumann, as follows: "The Diervillieae, for instance, have a surprising similarity in flower, fruit, and seed structure to the Cinchoneae; in the last analysis they are differentiated only by the lack of stipules in the former. Certain forms of Lonicereae, which are characterized by stipules (*Pentapyxis*), incline likewise to the tribe of Rubiaceae with numerous seeds, while some species of *Viburnum*, which are provided with stipules, harmonize with the Guettardeae."*

It would appear, therefore, that the Caprifoliaceae can not pass a test which should leave any satisfactory plant family intact, and with all due respect to those most erudite botanists, Bentham and Hooker, it would appear that their statement that the Caprifoliaceae are "a very natural order"† was made without sufficient consideration. Schumann appears to be more correct when he says "The Rubiaceae show the closest relationship to the Caprifoliaceae; various groups of them are so intimately related that one can raise no important objection to Baillon's view that the two families blend into one."

An even stronger statement is made by Fritsch relating to the group upon which he specialized: "The Caprifoliaceae are so closely allied to the Rubiaceae that it is impossible to give even one positive differential character for the two families."‡ It would

* Engler & Prantl, Die natürlichen Pflanzenfamilien 4^{4-5}:13. 1897.

† Genera Plantarum 2: 1. 1873.

‡ Engler & Prantl, Die natürlichen Pflanzenfamilien 4^{4-5} : 160. 1897.

appear, therefore, that the Caprifoliaceae have been treated as a separate family from the Rubiaceae on chiefly hypothetical grounds. Artificiality is hardly called for in this case since the number of genera concerned, namely ten, is so small in proportion to the 350 of Rubiaceae that separating them does not significantly decrease the complexity of the larger group.

INDEX TO AMERICAN BOTANICAL LITERATURE

1917–1921

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of three cents for each card. Selection of cards is not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

Ames, O. Notes on Philippine orchids—VII. In Ames, Orchidaceae **6**: 273–310. *pl. 98–101.* 18 O 1920.

Ames, O. Orchidaceae. fasc. VI. pp. i–xiv + 1–335. *pl. 80–101.* Boston, 18 O 1920.

Includes papers on The orchids of Mount Kinabalu, British North Borneo and Notes on Philippine orchids VII, here indexed separately.

Ames, O., & Schweinfurth, C. The orchids of Mount Kinabalu, British North Borneo. In Ames, Orchidaceae **6**: 3–233. *pl. 80–97.* 18 O 1920.

Anderson, J. P. Supplemental list of plants from southeastern Alaska. Proc. Iowa Acad. Sci. **26**: 327–331. 1919.

Arthur, J. C. Aecidiaceae (cont.). N. Am. Fl. **7**: 337–404. 31 D 1920.

Arthur, J. C. New species of Uredineae—XII. Bull. Torrey Club **47**: 465–480. 29 O 1920.

18 new species and several new combinations.

Bailey, C. H., & Gurjar, A. M. Respiration of cereal plants and grains. Jour. Biol. Chem. **44**: 5–7. *f. 1;* 9–12. *f. 1;* 13–15; 17, 18. O 1920.

Bakke, A. L., & Plagge, H. H. Studies upon the absorption and germination of wheat treated with formaldehyde. Proc. Iowa Acad. Sci. **26**: 365–375. *f. 96, 97.* 1919.

Barnhart, J. H. The so-called generic names of Ehrhart's Phytophylacium. Rhodora **22**: 180–182. 14 Jan 1921.

Berry, E. W. Contributions to the Mesozoic flora of the Atlantic coastal plain, XIII. North Carolina. Bull. Torrey Club **47**: 397–406 *f. 1, 2.* 19 O 1920.
Includes 3 new species.

Brown, W. H. Wild food plants of the Philippines. Philipp. Bur. For. Bull. 21: 1–165. *f. 1–81.* 1920.

Burt, E. A. The Thelephoraceae of North America—XII. Ann. Missouri Bot. Gard. **7**: 81–248. *pl. 2–6* + *f. 1–48.* 8 D 1920.
Includes 10 new species in *Stereum*.

Clute, W. N. Plant names and their meanings. Am. Bot. **26**: 2–10; 57–61; 90–94; 116–124. 1920.

Conard, H. S., & Thomas, W. A. Measurements of wood fiber. Proc. Iowa Acad. Sci. **26**: 333–335. 1919.

Cook, M. T. Report of the department of plant pathology. New Jersey Agr. Exp. Sta. Ann. Rep. **40**: 523–535. *pl. 1–6.* 1920.
Contains list of plant diseases.

Cratty, R. I. The genus *Lactuca* in Iowa. Proc. Iowa Acad. Sci. **26**: 239–248. *f. 83.* 1919.

Cratty, R. I. *Ranunculus Purshii* in Iowa. Rhodora **22**: 183. 14 Ja 1921.

Curtis, O. F. The upward translocation of foods in woody plants. II. Is there normally an upward transfer of storage foods from the roots or trunk to the growing shoots? Am. Jour. Bot. **7**: 286–295. 6 Au 1920.

Davis, W. H. Mammoth clover rust. Proc. Iowa Acad. Sci. **26**: 249–258. *f. 84–90.* 1919.

Deam, C. C. Plants new to Indiana—VIII. Proc. Indiana Acad. Sci. **1918**: 144–150. 1919.

Detwiler, S. M. Safeguarding the white pine crop. Am. For. **27**: 7–11. Ja 1921.

Ensign, E. *Rosa pratincola* Greene. Proc. Iowa Acad. Sci. **26**: 303–310. 1919.

Fernald, M. L., & Wiegand, K. M. Studies of some boreal American cerastiums of the section *Orthodon*. Rhodora **22**: 169–179. 14 Ja 1921.
Includes *Cerastium terrae-novae* sp. nov.

Fitzpatrick, T. J. The fern flora of Nebraska. Proc. Iowa Acad. Sci. **26**: 311–326. 1919.

Gustafson, F. G. Comparative studies on respiration—XI. The effect of hydrogen ion concentration on the respiration of *Penicillium chrysogenum*. Jour. Gen. Physiol. **2**: 617–626. 20 Jl 1920.

Gustafson, F. G. Comparative studies on respiration—XII. A comparison of the production of carbon dioxide by *Penicillium* and by a solution of dextrose and hydrogen peroxide. Jour. Gen. Physiol. **3**: 35–39. *f. 152.* 20 S 1920.

Haupt, A. W. Gametophyte and sex organs of *Reboulia hemisphaerica*. Bot. Gaz. **71**: 61–74. *f. 1–21.* 20 Ja 1921.

Hervey, E. W. A rare variety of *Vitis labrusca*. Rhodora **22**: 183, 184. 14 Ja 1921.

House, H. D. Wild flowers of New York. New York State Museum Mem. **15**: 9–362. *pl. 1–264* + *f. 1–35.* 1919.
Printed in 2 parts.

Hoyt, W. D. Marine algae of Beaufort, N[orth] C[arolina], and adjacent regions. Bull. U. S. Bur. Fish. **36**: 368–556 + iv. *pl. 84–118* + *f. 1–47.* 30 D 1920.
Includes new species in *Streblonema* (1) and *Nitophyllum.* (1).

Jeffrey, E. C., & Torrey, R. E. Physiological and morphological correlations in herbaceous angiosperms. Bot. Gaz. **71**: 1–31. *pl. 1–7* + *f. 1–4.* 20 Ja 1921.

Kelley, W. P., & Cummins, A. B. Composition of normal and mottled citrus leaves. Jour. Agric. Research **20**: 161–191. 1 N 1920.

Kränzlin, F. Orchidaceae quaedam Americanae. Vidensk. Meddel. Dansk. Naturh. Forening **71**: 169–180.
Includes new American species in *Pleurothallis* (2), *Restrepia* (1), *Sobralia* (1) *Macradenia* (1), *Warmingia* (1), *Habenaria* (2).

Kudo, R. Studies on Myxosporidia. Illinois Biol. Monog. **5**, No. 3, 4: 1–265. *pl. 1–25* + *f. 1, 2.* 31 D 1920.
A synopsis of genera and species of Myxosporidia.

Ladbrook, J. A new species of *Coupoui*. Jour. Bot. **58**: 176, 177. Jl 1920.
Coupoui micrantha from Guiana.

Lamb, G. N. American grown cork. Am. For. **27**: 15, 16. Ja 1921.

Leachman, J. C. Indian uses of kelp. Sci. Am. Mo. **3**: 137–140. F 1921.

Lillie, R. S. The place of life in nature. Sci. Am. Mo. **3**: 112–117. F 1921.

Lloyd, C. G. Mycological notes **64**: 985–1029. *f. 1748–1859* + *3 portraits.* S 1920.
Includes translation of article by C. Torrend: The Polyporaceae of Brazil.

Loeb, J. Quantitative laws in regeneration. Jour. Gen. Physiol. **2**: 297–307. *f. 1–4*; 651–657. *f. 1–3*. 20 Jl 1920.
Studied *Bryophyllum calycinum* Salisb.

Mazza, A. Saggio di algologia oceanica. Nuova Notarisia **28**: 70–110; 176–239. 1917; **29**: 1–34; 57–112. 1918.

Mazza, A. Aggiunte al saggio di algologia oceanica. Nuova Notarisia **30**: 1–62. 1919; **31**: 1–64; 93–160. 1920.

Munns, E. R. High temperatures and eucalypts. Jour. For. **19**: 25–33. Ja 1921.

Nash, G. V. Hardy woody plants in the New York Botanical Garden. Jour. N. Y. Bot. Gard. **21**: 74–77; 119–124. 1920.

Noriega, J. M. Las plantas Mexicanas (*cont.*). Bol. Dir. Estud. Biol. **2**: 122–151. *f. 18–31*. Ja 1917.

Ostenfeld, C. H. A list of arctic Caryophyllaceae. Meddel. Grönland **37**: 223–227. 1920.
Includes several new combinations.

Pack, D. A. After-ripening and germination of *Juniperus* seeds. Bot. Gaz. **71**: 32–60. *f. 1*. 20 Ja 1921.

Pammel, L. H. The barberry in Iowa and adjacent states. Proc. Iowa Acad. Sci. **26**: 193–237. *f. 52–82*. 1919.

Pammel, L. H. The relation of native grasses to *Puccinia graminis* in the region of Iowa, western Illinois, Wisconsin, south[illegible]n Minnesota, and eastern South Dakota. Proc. Iowa Acad. Sci. **26**: 163–192. *f. 41–51*. 1919.

Peck, M. E. Study of a section of Oregon coast flora. Proc. Iowa Acad. Sci. **26**: 337–362. 1919.

Reinking, O. A. Higher Basidiomycetes from the Phi[illegible]d their hosts—III. Philipp. Jour. Sci. **16**: 527–537. M[illegible]

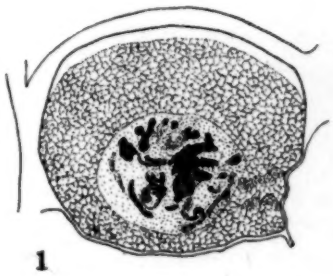
[H. H. Rusby]. New botanical drugs sought. Pha[illegible] 321–324. N 1920.

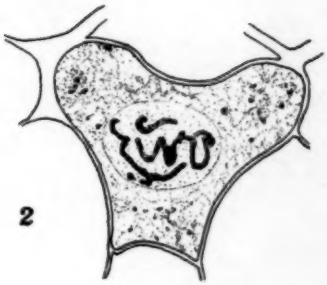
Rydberg, P. A. Notes on Rosaceae—XII. Roses of [illegible] North America. Bull. Torrey Club **47**: 45–66. 10 Mr

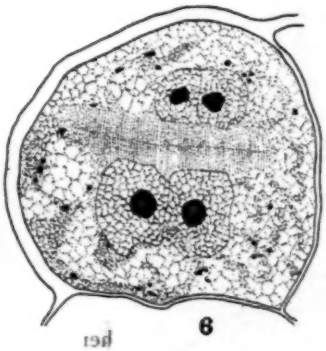
Rydberg, P. A. Phytogeographical notes on the Rocky Mountain region—IX. Wooded formations of the Montane Zone of the Southern Rockies. Bull. Torrey Club **47**: 441–454. [illegible]9 O 1920.

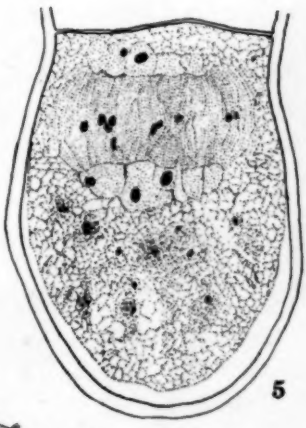
Sawyer, M. L. Hybridization in *Iris*. Proc. Iowa Acad. Sci. **26**: 363, 364. 1919.

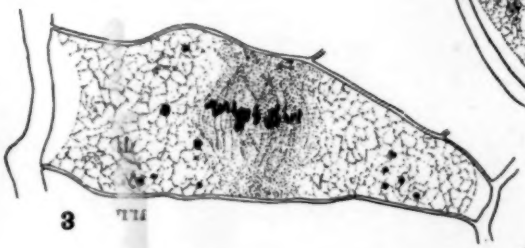
Schufeldt, R. W. Tramps through the Southern States—II. Am. For. **26**: 540–547. S 1920. [Illust.]

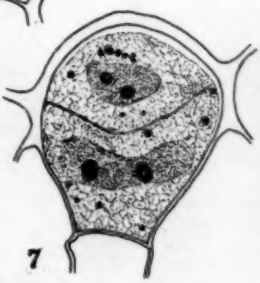












RIKER: CHONDRIOMES IN CHARA